REMARKS

The specification as filed is a literal translation of a patent application that was originally written in Spanish, and conforming to European standards and practices. In the interest of clarity and understanding, the attached replacement specification and drawings have been prepared, which conform to U.S. engineering and patent standards and practices. Although the replacement specification differs in form from the original specification, the Applicants respectfully maintain that the replacement specification adds no new matter, because this replacement specification has been prepared based solely upon the information contained within the original filing.

The attached drawing shows proposed changes marked in red. If approved by the Examiner, formal drawings will be submitted.

The claims are amended to conform to U.S. patent practice, and to eliminate multiple dependent claims.

Respectfully submitted,

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CERTIFICATE OF MAILING OR TRANSMISSION

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On 16 October 2002 **By __________**

ATTACHMENT SHOWING THE CHANGES MADE TO THE SPECIFICATION

VOLTAGE STABILI~~S~~ZER FOR ELECTRICAL ENERGY TRANSPORTATION AND DISTRIBUTION APPLICATIONS

~~SPECIFICATION~~

~~OBJECT OF THE INVENTION~~

~~The herein descriptive specification refers to an Invention Patent application, in relation to a voltage stabiliser for electrical energy transportation and distribution applications, the aim of which is to enable its use as a voltage stabiliser at different electrical energy voltage levels, capable of being installed in single phase and three phase networks, consisting of one or several electromagnetic devices of transformer type and which, in incremental steps, regulates the output voltage which reaches the consumers.~~

~~FIELD OF THE INVENTION~~

~~This invention is for application within the industry dedicated to the distribution of electrical energy, to be precise within electrical networks with large voltage drops.~~

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of electrical energy transportation and distribution, and in particular to a voltage stabilizer/booster that regulates output voltage in incremental steps.

2. Description of Related Art

Problems with the regulation of voltage in electrical energy distribution ~~networks are customary, as is the implantation of equipment with the aim of mitigating the problem.~~ are known in the art, as are techniques and systems that mitigate the problem.

~~Worth mentioning is the embodiment as auto-transformers with intake points,~~ Autotransformers are commonly used to regulate and/or boost an input voltage to provide a constant output voltage regardless of voltage drops on the input. Typically, such autotransformers are controlled by static or mechanical switches, ~~as well as~~ or via the use

of ~~motorised, continuously regulated auto-transformers.~~ motorized, continuously adjusted autotransformers. Such equipment is typically expensive, and/or somewhat unreliable.

~~This equipment performs the function required of them, but at the price of a large economic investment and/or a considerable reduction in supply reliability.~~

~~For its part the applicant is unaware of the current existence of any voltage stabiliser for electrical energy transportation and distribution applications that is designed to be implanted in electrical networks with large voltage drops and which presents the same features as the one described in this specification.~~

~~DESCRIPTION OF THE INVENTION~~

~~The voltage stabiliser for electrical energy transportation and distribution applications proposed by the invention constitutes in itself an evident innovation within its field of application.~~

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide a voltage stabilizer that can be used at different electrical energy voltage levels, capable of being installed in single-phase or three-phase networks, to provide a regulated output voltage.

This objects and others are achieved via a voltage stabilizer ~~To be more precise, the voltage stabiliser for electrical energy transportation and distribution applications takes the form of a voltage stabiliser for electrical energy transportation and distribution applications, admitting of installation in single phase and three phase networks,~~ consisting of one or more electromagnetic devices of transformer type, and which, in incremental steps, regulates the output voltage, particularly within electrical networks with large voltage drops ~~which reaches the consumers~~.

The basic regulation device consists of a transformer with a primary dual or quadruple winding, and with a simple secondary winding, that is configured ~~prepared~~ to withstand the supply line's full intensity. The secondary is configured to lie in series between the supply input and the regulated output, and may be positioned before of after the configurable primary branch. ~~The simple winding may be positioned before or after the parallel branch, the performance of the equipment remaining the same. With the aid of the appropriate commutation~~ Via appropriate configurations of the primary windings,

corrections are made to the output voltage, with the purpose of keeping it within pre-set margins.

This basic element offers features of very considerable economy, robustness and efficacy, the output discretisation being five or nine-step, which makes the invention of interest to installations where there is a major problem of voltage regulation and where a coarse regulation is required at around the nominal voltage value.

Nevertheless, should greater resolution be needed, the invention admits the use of devices in series, with regulations stepped 4:1.

~~DESCRIPTION OF THE DRAWINGS~~

~~In order to complement the herein description, and with the aim of assisting in the better understanding of the invention's characteristics, attached to the herein specification, and forming an integral part of it, is a set of plans in which, by way of illustration and in no way limiting, the following has been depicted:~~

~~Figure 1.- offers a graphic representation of the single phase scheme equivalent of the equipment's power circuit and shows, to be more precise, the downstream compensation which allows the main transformer's power to be reduced, at the price of not exploiting to the full the magnetic circuit at non-nominal voltages. Figure 1 corresponds to the object of the invention relating to a voltage stabiliser for electrical energy transportation and distribution applications.~~

~~Figure 2.- offers a view similar to that shown in figure 1, exploiting to the full the magnetic circuit at non-nominal voltages as a consequence of upstream compensation.~~

~~PREFERRED EMBODIMENT OF THE INVENTION~~

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in further detail, and by way of example, with reference to the accompanying drawings wherein:

FIG. 1 illustrates an example diagram of a single-phase voltage stabilizing device in accordance with this invention, wherein the secondary winding is placed after the primary branch, thereby allowing the transformer power to be reduced, at the cost of not fully exploiting the range of voltage regulation available.

FIG. 2 illustrates an example diagram of a single-phase voltage stabilizing device in accordance with this invention, wherein the secondary winding is placed before the

primary branch, thereby fully exploiting the range of voltage regulation available from this device.

Throughout the drawings, the same reference numerals indicate similar or corresponding features or functions.

DETAILED DESCRIPTION OF THE INVENTION

The voltage stabilizer of this invention may be embodied for a single-phase transformation, or thrice replicated for use in a three-phase network. In a three-phase application, independent control of each phase may be provided, or a common control, using multi-pole switches, may be employed, as will be evident to one of ordinary skill in the art in view of this disclosure. ~~The voltage stabiliser for electrical energy transportation and distribution applications which is being proposed and which is specifically designed for electrical energy transportation and distribution applications, may be embodied for a single phase or three phase network. The elements specified are those used in the single phase equipment, but it should be pointed out that the construction of the three phase stabiliser is immediate given that all that is needed is to triplicate the equipment if one control per phase is desired, or to triplicate the number of contactor and relay poles, should a joint control be desired.~~

~~As may be seen in figures 1 and 2, there~~ There are two variants of the invention, distinguished by whether the line compensation (secondary coil) lies "downstream" (FIG. 1), or "upstream" (FIG. 2) of the primary branch, which lies parallel to the input supply in each variant ~~single phase scheme equivalent of the equipment's power circuit, the difference as shown between both residing in the fact of whether the line compensation is before or after the parallel branch~~. The downstream compensation, shown in figure 1, allows the main transformer's power to be reduced, at the price of not exploiting to the full the magnetic circuit at non-nominal voltages. There is full exploitation in upstream compensation, the scheme for which is shown in figure 2.

~~The voltage stabiliser for electrical energy transportation and distribution applications is composed of~~ In each of the variants, the voltage stabilizer comprises a transformer, trip/contact/relay elements, and a controller ~~panel~~. The controller (not illustrated) controls each of the switches/relay elements SC, SR1, and SR2, as detailed

below, and is preferably implemented as a microprocessor that measures the output voltage Vout. The switch/relay SC is a power-cutting element that controls whether to engage the transformer to effect an increase or decrease in the output voltage.

The transformer ~~takes the shape of a transformer whose primary voltage is the same as the line's nominal single phase voltage (Vfn), as referred to in the figures mentioned above, and whose secondary voltage is the same as the maximum voltage increase that it is wished to inject into the line (Viny), also to be seen in the figures.~~ comprises primary coils P1 and P2, and secondary coil S. The primary coils P1 and P2 are configured, via the switch SR1 to be either in parallel, or in series, with each other, and in parallel with the input supply voltage (FIG. 1), or the output supply voltage (FIG. 2). The switch SR2 determines the direction of coupling (polarity) between the primary P1, P2 and secondary S coil arrangements. The primary coils P1 and P2 are substantially identical to each other, and have substantially equivalent coupling to the secondary coil S.

~~The primary winding is coiled double in two electromagnetically identical coils. This enables it to be connected at the 2*Vfn/Viny connection too.~~

~~In the case of downstream compensation, as shown in figure 1, the power of this machine will be Viny*Ilinea, where Ilinea is the nominal current of the line on the stabilised side. In the case of upstream compensation, the scheme for which is shown in figure 2, the power of this machine will be Viny*Ilinea (l+Viny/Vfn), albeit the services of compensation provided are higher.~~

~~With respect to the trip/contactor/relay elements, it should be pointed out that the equipment requires a power-cutting element (Cl) with one normally closed contact (NC) and another normally open (NO), at a nominal line current.~~

~~In addition two isolator elements (R1 and R2) are needed, each of which is provided with two normally open contacts and two normally closed contacts (NO and NC respectively), with a nominal V_{fn}/V_{iny}, the current of the line. These two elements may be substituted by static cutting elements.~~

~~As for the control panel, it should be pointed out that it consists of a microprocessor which measure the output voltage and sends the orders to the trip,~~

~~contactor and relay elements, in order that they are correctly configured for adjusting the voltage within limits.~~

~~As for the mode of operation, it should be pointed out that the configuration of the contactors as shown in figure 1 allows for five possible manoeuvres to be carried out. Namely:~~

~~- With Cl, that is to say the power cutting elements, at rest and the isolator elements in any position, the equipment is physically disconnected from the network. It should be pointed out that this mode of operation allows the continuity of the supply to be guaranteed in the face of a failure in the equipment, as well as avoiding the introduction of losses in the non-stabilisation situation.~~

~~- With Cl activated and the two isolator elements at rest, the regulator multiplies the input voltage by~~ $\cancel{(1+0.5* V_{fn}/V_{iny})}$~~. In nominal conditions this means an injection of~~ $\cancel{+0.5* V_{fn}/V}$~~.~~

~~- With Cl and R1 activated and R2 at rest, the regulator injects into the network a voltage of~~ $\cancel{+V_{iny}}$ ~~V in nominal conditions.~~

~~- With Cl and R2 activated and R1 at rest, the regulator injects into the network a voltage of~~ $\cancel{-0.5\ V_{iny}}$ ~~V in nominal conditions.~~

~~- With Cl, Rl and R2 activated, the regulator injects into the network a voltage of~~ $\cancel{-V_{iny}}$ ~~V in nominal conditions.~~

The configurations shown in FIGs. 1 and 2 allow for five possible states of the transformer arrangement, as follows:

With SC in the position illustrated, the secondary coil S is bypassed, and the primary coils P1, P2 are disengaged. In this state, the output voltage Vout will equal the input voltage Vin. Preferably, this state is the default state, thereby allowing a continuous output voltage in the event of a failure of one or more of the elements comprising the voltage stabilizer.

With SC in a position opposite to that illustrated, the secondary coil S is placed in series between the input voltage Vin and the output voltage Vout, and the primary coils are engaged. In this state, the output voltage is given as:

$$Vout = Vin + Vs,$$

Where Vs is the voltage across the secondary coils S.

At the positions illustrated, the primary coils are coupled in series with each other, via SR1, and the coupling, via SR2, places the voltage Vs across the secondary coil S in phase with the input voltage Vin. Assuming that the number of turns in each primary is Np and the number of turns in the secondary is Ns, the voltage across the secondary coil S, and the output voltage are given as:

Vs = Vp*Ns/(2*Np), and

Vout = Vin + Vp*Ns/(2*Np),

where Vp is the voltage across the primary branch, and the 2*Np term is due to the fact that two primary coils, each of Np turns, are connected in series within this branch. When SR2 is in the position opposite to the position shown in the figures, the phase of the induced voltage in the secondary S is reversed, and

Vout = Vin – Vp*Ns/(2*Np).

When SR1 is in the position opposite to the position in the figures, and SR2 is as illustrated, the primary coils are connected in parallel. In this state, the voltage across the secondary coil S, and the output voltage are given as:

Vs = Vp*Ns/Np, and

Vout = Vin + Vp*Ns/Np.

When SR2 is in the position opposite to the position in the figures, the phase of the induced voltage in the secondary S is reversed, and

Vout = Vin – Vp*Ns/Np.

~~That is to say, Cl, to be precise the power cutting element, connects the equipment, while one isolator element (Rl) determines the magnitude of the trip (0.5*V_{inv} or V_{inv}) and the other isolator element (R2) determines the configuration's polarity (+/-).~~

In FIG. 1, Vp corresponds to Vin, whereas, in FIG. 2, Vp corresponds to Vout. Table 1 illustrates the output voltage for each state of the switches/relays SC, SR1, SR2, wherein "0" corresponds to the de-asserted states illustrated in the figures, and "1" corresponds to the asserted opposite state.

SC	SR1	SR2	Vout	Vout

			FIG. 1	FIG. 2
0	-	-	Vin	Vin
1	0	0	Vin(1+0.5*Ns/Np)	Vin/(1-0.5*Ns/Np)
1	0	1	Vin(1-0.5*Ns/Np)	Vin/(1+0.5*Ns/Np)
1	1	0	Vin(1+Ns/Np)	Vin/(1-Ns/Np)
1	1	1	Vin(1-Ns/Np)	Vin/(1+Ns/Np)

TABLE 1

~~The control of the basic element measures in network cycle real time the effective values of the equipment's output voltages, thus permitting them to be stabilised within a margin of [V_{fn} +/- V_{iny}/4], provided that the input voltage lies within the interval [V_{fn} +/- V_{iny}/4].~~

As illustrated, the circuits of FIGs. 1 and 2 provide five incremental steps of voltage adjustment, corresponding to increments of 0.5*Ns/Np. When four primaries are provided, the switch/relay SR1 is configured to provide one, two, three, or four coils in series, thereby providing incremental steps corresponding to increments of 0.25*Ns/Np.

~~The voltage compensation manoeuvres are carried out in line with the following process, namely:~~

~~1. Deactivation of Cl.~~

~~2. With the aid of Cl's auxiliary contact, verification that the manoeuvre was carried out correctly.~~

~~3. Activation/deactivation of Rl and R2 (manoeuvre without voltage or current).~~

~~4. Activation of C1.~~

In a preferred embodiment of this invention, the controller is configured to measure the output voltage Vout periodically, and correspondingly adjusts the switches/relays SC, SR1, SR2 as required to incrementally increase or decrease the output voltage. Preferably, when a change of state of SR1 or SR2 is required, SC is deasserted to disengage the primary coils before the change of state is introduced.

The foregoing merely illustrates the principles of the invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements which,

although not explicitly described or shown herein, embody the principles of the invention and are thus within the spirit and scope of the following claims.